

FORMATION OF CH⁺: SHOCK CHEMISTRY IN NGC 7027

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The formation of CH⁺ in the interstellar medium has been an enigma for the past 70 years. Emission from the species is found in diffuse material, even though the major pathway leading to the species, C⁺ + H₂, is endothermic by 0.40 eV. The barrier for this reaction can be greatly reduced if the H₂ is vibrationally excited. Using the Heterodyne Instrument for the Far Infrared (HIFI) on board the Herschel Space Observatory, we have mapped CH⁺ ($J = 1 \rightarrow 0$), CH⁺ ($J = 2 \rightarrow 1$), and C⁺ ($J = 3/2 \rightarrow 1/2$) across the face of the young planetary nebula, NGC 7027. Analysis of the spectra has shown that CH⁺, C⁺, and vibrationally excited H₂ apparently trace the same outflow in NGC 7027. Therefore CH⁺ in this nebula likely forms from the activated C⁺ + H₂ reaction. Spectral maps, temperatures, and abundances of CH⁺ will be presented along with spectral maps of C⁺.